Area-wide Control of the Oriental Fruit Fly and Melon Fly in Taiwan

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ABSTRACT

Area-wide control have been tested for the oriental fruit fly (*Bactrocera dorsalis* Hendel, OFF) and melon fly (*Bactrocera cucurbitae* Coquillett) in Taiwan. The control tactics depend mainly on methyl eugenol, cuelure, and protein bait containing spinosad. The non-chemical efforts are concentrated on (1) organize involved farmers, (2) establish geological information, (3) monitor fruit fly density, (4) establish fruit production information (5) hold training programs and (6) maintaining the orchard sanitation. Area-wide OFF control had been tested from the year of 2000 to 2004 in 21 districts, and the result indicated that farmers with common interest, mainly in a monocrop system, will cooperate better than those planting multiple crops. Taitung area presents a fruitful result due to sugar apple, *Annona squamosa* L., constitutes 95% of its fruit production, and OFF density ratio regulated in inner quarter, buffer zone, and outskirt is 1 : 10 : 30-100. Within three year, control acreage in Taitung has expanded from 4000 ha to 10000 ha and then to 15000ha. Although GIS/GPS technologies have been used in density monitoring and control strategy planning, 3-dimentional aerial photo have gained stronger echo from the local farmers. The 3-D digital displayed system creates a "virtual reality" of targeted areas on screen which ignites farmers' interest because they can overlook their own orchard and the whole control area. Bring the whole area into a conference room has contributed to the enthusiastic participation in the ongoing area-wide control program, combining the pest density data also give farmers a plan of work, and more details on control strategy can be discussed.

Key words: Area-wide control, Bactrocera dorsalis, Bactrocera cucurbitae.

INTRODUCTION

The fruit fly control project was improved by (1) establishing an island-wide 10-day interval's fruit fly density monitoring system since 1994, (2) controlling the quality of the lure, and (3) testing better field application strategies. By suggesting correct suppression measures for farmers, the oriental fruit fly population has been suppressed to a level of 15 % of pre-control density. These efforts were supported by the funding from government for purchasing 40 tons methyl eugenol (ME) per year, and then manufactured more than two millions ME fiberboard baits to cover 150,000 ha orchards. Fruit crops protected are mango, wax apple,

citrus, guava, peach, pear, sugar apple, carambola, etc.

In this project, we continuously exchange ideas with the Hawaiian fruit fly control working team. The new approaches applied in the area-wide control strategies include the improvement of ME baits, incorporate new traps and protein bait, GF-120. We successfully organize 155 farmer associations to synchronize the fruit fly control project. However, numerous technology developed in recent years have been incorporated into the program, particularly, the GEO information as well as computerized data processing in pest monitoring and damage assessment.

MATERIALS AND METHODS

1. Attractants and baits used: methyl eugenol, cuelure, GF-120 and other protein hydrolysate baits.
2. Test insects: oriental fruit fly and melon fly.
3. Traps: improved trap using fiber board/cloth was designed, which can periodically reload fresh ME bait mixture.
4. Monitoring trap: the pheromone trap for *Spodoptera exigua* has been used.
5. Poisoned baits: 95% naled mixed with insect attractants (methyl eugenol or cuelure) at the ratio of 5 to 95.
6. Forecasting model construction and analysis of population change rate.
7. New software for GIS/GPS systems.
8. Aerial photos combining with the 3-dimentioanl digital display software.

RESULTS AND DISCUSSION

Establish Area-wide Fruit Fly Control Districts

With the cooperation of the Hawaiian fruit fly working team, the official fruit fly control program sponsored by the Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ), this area-wide (AW) control program has advanced rapidly, particularly on the establishment and extension of AW control strategy. For example, starting in 2002 after intensively field survey and discussion with the farmers and staffs of Taitung Farmer Association, the OFF density monitoring has been initiated for their AW control district.

Taitung is the earliest established AW control district, which initially covering an area of 4,000 ha, and was expanded to 15,000ha in 2005. The frontier, the buffer zone and the inner circle were established, and each has its own density data to realize the fruit fly invasion from the western mountainous side. Fruit fly of frontier, buffer zone an inner circle has a density gradient of 30-100 : 10 : 1, and the fruit fly damage in Taitung has been minimized in sugar apple (Fig. 1).

The active "search and destroyed" monitoring tactic has also been tested since 2002, in another 15 control districts covered a total of more than 10000 ha in the west coast (Fig. 2). Amongst these areas, Tou-lieu AW district is the most successful district with outer and inner OFF density difference exceeds 70 times. However, other AW districts still not able to reach the first stage implementation target, i.e., a differences of 3 to 10 times.

In 2005, four new districts are established, which located in Hua-lien in east coast of Taiwan, and one hundred km north from Taitung. Only in their first year of OFF control, the farmers have already gained success result in pomelo.

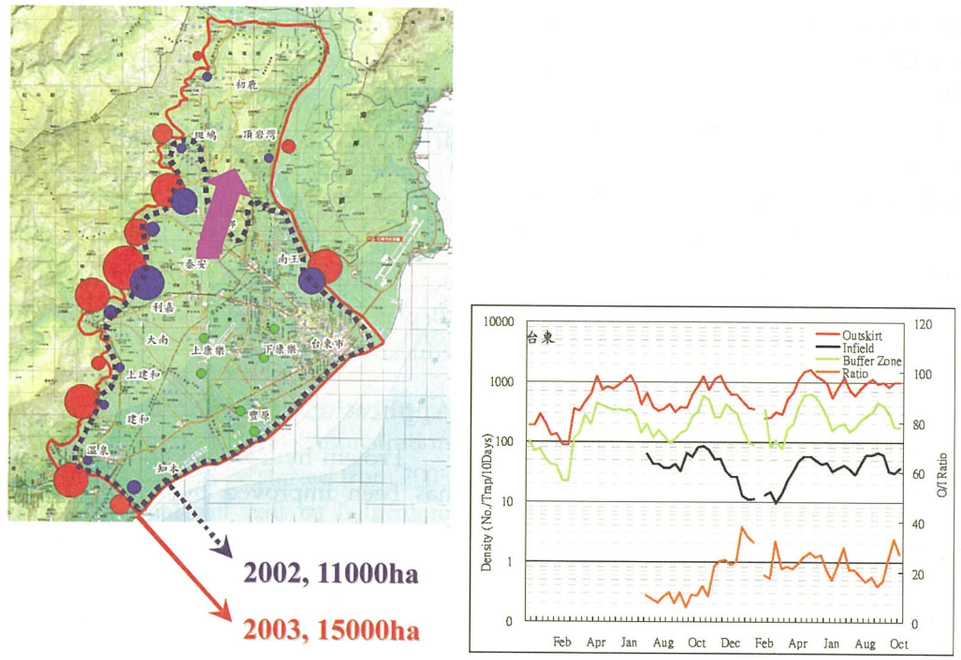

Fig. 1. Oriental fruit fly density monitored in Taitung AW control district in Dec. 2003 (innermost: green spot; inner: blue spot; outer: red spot).

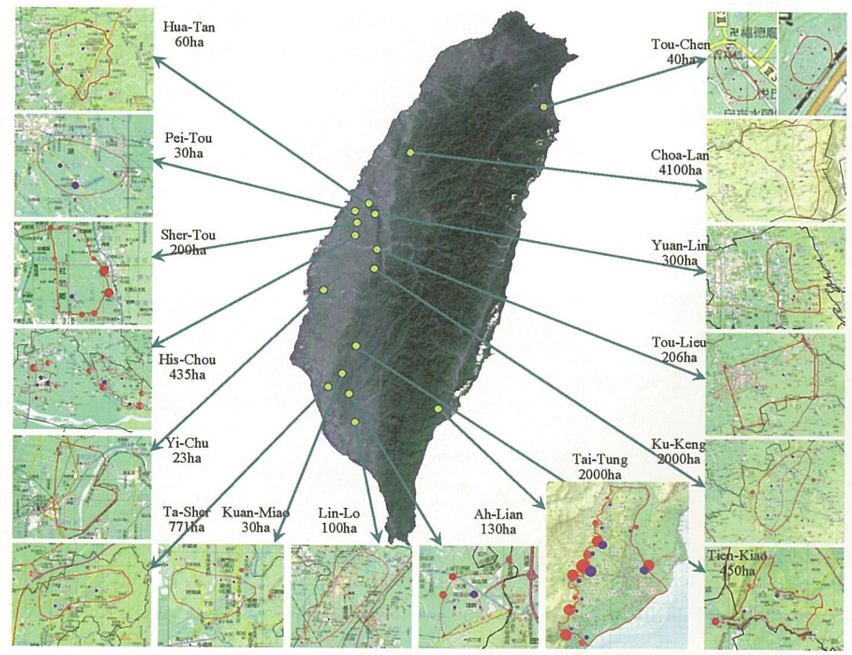

Fig. 2. Sixteen established OFF AW control districts in Taiwan, 2002-2004.

Tree other new control districts are in Chia-yi County, and the acreage of each district does not exceed 1,000 ha., but the OFF control results have exceeded 15 previously established districts in west coast. The main reason for this success is due to the incorporation of 3-D aerial photo digital system in the meeting of planning and designing the control strategy with the farmers. This new advance has been considered as a breakthrough to our previous believes that the AW control area should be as large as possible, and can not be succeeded in a small area. Through detailed discussion and planning, and with the help of 3-D aerial photo illustration, farmers of these small control districts are more enthusiastic, and enable us to get more involvement of farmers in OFF control details (Fig. 3).

Farmer Education

Farmer education program has been continued. The cage for demonstrating the actions of ME and cuelure on FF and MF has resulted very convincing visual confirmation of the bait's action to farmers, and has become an essential part in the farmer's education session. The 3-D aerial photo display also offers great help in farmer education sessions.

Application of Protein Baits

Protein hydrolysate application method has been improved by adding borax and sodium hydroxide to increase the pH value, which will increase the ammonia component of food bait and resulted in better trapping effect. Procedures for blending the mixture is well illustrated in a pamphlet and dispatched to 155 farmer associations.

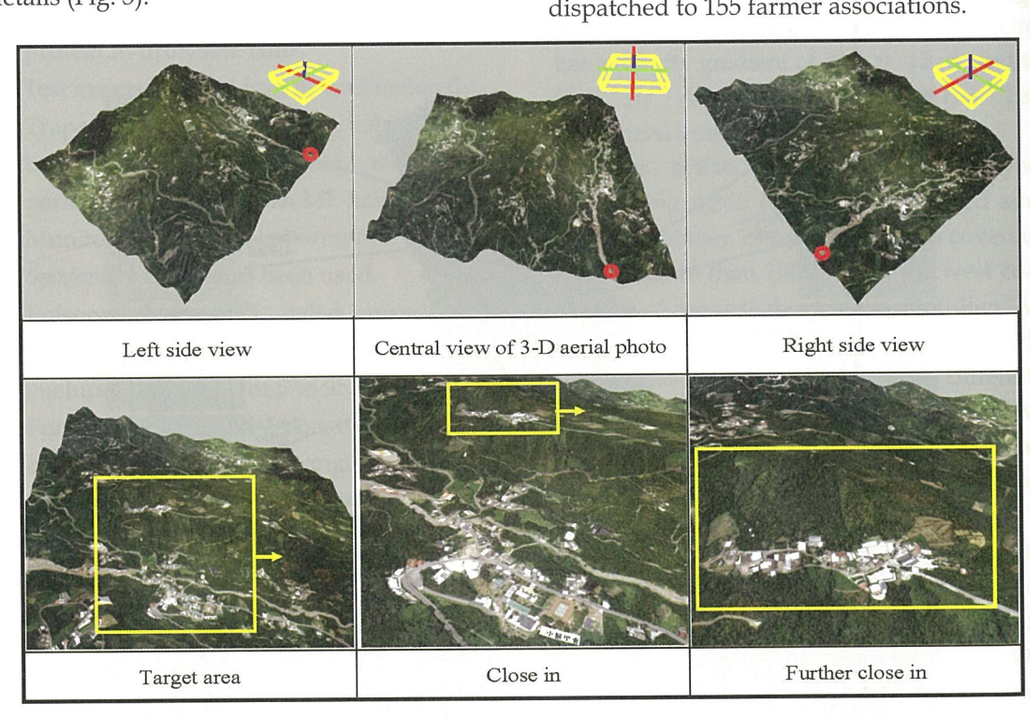

Fig. 3. The newly established AW control district, Chuen-nan Village, shown in the 3-D digital display system.

With the help of Dr. Ronald Mau and the Dow Chemicals, the new protein bait, GF-120, has been successfully introduced to Taiwan in 2003. Two demonstration orchards have applied GF-120 and compared to the traditional protein baits for education and extension purposes. The effects of GF-120 are also introduced to several districts that produce luffa, melons and cantaloupe for melon fly control, and current peak control period is spring to summer (Fig. 4).

GF-120 has received its registration in Taiwan in 2005. Official demonstration program for GF-120 will be started from 2005 and this useful material will be helpful to reduce the female fruit fly density in an OFF outbreak and also reduce the environmental hazard of chemical insecticides.

Orchard Sanitation

Enhance field sanitation has been conducted in the four newly established AW control districts in both Hua-lien and Chia-yi Counties in 2005 (Fig. 5).

Issuing the OFF Newsletter Every Ten days

The island-wide OFF monitoring network continuously provides population census data, which enables the working team to analyze OFF population dynamics and to construct the forecasting model. These analytical works proved to be useful in identifying high-density location and season when OFF increase rate reach the high level. The obtained information then feedbacks to the local farmer associations in a pre-warning system for fruit fly control on the newsletter in 10-day interval (Fig. 6). In our planning, all those information will be available at the ARI's website from September, 2005.

Fig. 4 Field discussion on the application of GF-120 on trap crops.

Fig. 5. Plastic containers provide to farmer for field sanitation.

Fig. 6. Newsletter published every 10 days showing fruit fly density in different areas and the density differences in established AW control districts.

The density of the oriental fruit fly for the past 12 year has under the ME bait control distributed by the government. Although AW control districts have only been established for 3-4 years, the know-how of new technology developed in this program has been refined through the corporation of Hawaiian researchers. At the end of four years's program, the sign of success of this modernization effort is demonstrated clearly in both large district such as Taitung, as well as the small districts in Chia-yi County.

Complete AW control research work will be documented in a standard operation manual by ARI with the opinion and comments from Hawaiian research Group. The manual will serve as a frame work and guideline for future OFF control work in different situations and may also serve as the preparation step for fruit exportation through quarantine.

The farmer's group will always be invited in the meetings to discuss their success and failure, particularly in the conclusion meeting of this COA/USDA collaboration program held in October 12-13, 2005 in Taiwan. Invited participants also included Dr. Ronald F. L. Mau, Dr. Eric B. Jang and Dr. Roger I. Vargas.

The Taiwan experience in this program has gained the recognition of Hawaiian fruit fly working group and had been invited to the 5th APCE meeting held Jeju, Korea as the co-chair in the fruit fly session, and to exchange the experiences obtained in this cooperative research project conducted during 2000-2004 with participants from other countries.

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